



2012 Annual Efficiencies Report

Utah Department of Transportation

State Legislature Version

January 2013



Introduction

Efficiencies in the Utah Department of Transportation (Department) often generate cost savings for the public and the Department through better utilization of resources and innovative technologies. This report contains summaries of key efficiency initiatives, selected by Department Executive Management, from State Fiscal Year 2012. These efficiencies highlight the significant progress made in accomplishing the Strategic Goals of the Department during 2012.

The Strategic Goals of the Department are shown below:

- Preserve Infrastructure
- Optimize Mobility
- Zero Fatalities
- Strengthen the Economy

This report fulfills a requirement for the Department to describe the efficiencies and significant accomplishments achieved during the last year to the State Legislature. Statements of time and cost savings are best estimates at the time of document preparation. This and past annual reports are available online at www.udot.utah.gov/go/efficiencies.

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Environmental Matrix Organization

Savings: Potential time and cost savings from the reorganization of environmental staff resources.

Efficiency: Applied resources where and when they were needed to create consistency and develop employees.

Over the past year the Department has shifted its environmental staff to a matrix structure, where individuals with similar but specialized abilities have been grouped into a unit that enables applying those abilities where they are needed most. UDOT began looking at expanding the use of matrix organizations due to concerns with core competency, training, resource allocation, and consistency across four Regions and the central office. UDOT has operated in a decentralized organizational structure with much success and has further optimized the organization by implementing a matrix structure in its Environmental Divisions, similar to that of Project Management.

The goals of the Environmental Matrix Organization are to 1) Increase Efficiency, 2) Improve Consistency and 3) Enhance Core Competency. These will be achieved by:

1. Applying resources where and when needed given our fluctuating workload.
2. Being more consistent in our analysis approach and communication with our partners (e.g. Federal and State agencies, Local Governments, Region clients).
3. Creating opportunities for employees to gain experience and develop a broader level of understanding in identified environmental resource areas.

Using the matrix structure has allowed UDOT environmental staff to better utilize our existing staff while also providing them with additional experience that will benefit them in their career, as well as help the Department meet its goals. Time and cost savings will be tracked going forward to document the benefits of this organizational change.

Improved Asset Inventory Using LiDAR Point Cloud

Savings: Estimated cost savings per year of \$250,000

Efficiency: Reduced surveying cost while improving accuracy in asset data collection

Good roads cost less; the most effective way to preserve the transportation system is to continue regularly scheduled upkeep to prevent deterioration. The Asset Management group in the Department is leading the effort to improve infrastructure while saving money and lives.

The Department has approximately \$30 billion in its inventory of assets, such as pavements, bridges, signs and culverts. Recently, a Department effort was initiated

to geo-locate nearly all above ground highway assets. The integrated effort includes Divisions across the Department. Assets to be collected include: pavement distress, roadway geometry, pavement surfaces, pavement markings, signs, traffic signals, intersections, walls, barriers, structure clearance, and billboards. The Department will be able to rigorously analyze its entire geo-spatially located inventory. As just one of many examples, analysis of integrated safety crash data, roadway geometry, assets, pavement friction and traffic volume will potentially lead to selections of the most appropriate safety projects with the most applicable safety treatments, thereby allocating and stretching limited funds.

LiDAR (Light Detection And Ranging) is used in connection with high definition right of way imaging to collect and post process all of the assets that are found within the range of the LiDAR. The sensors can collect up to 1.6 million points of data per second. The points are then used to create a three-dimensional, high-definition model of the surrounding environment. The post processing involves analyzing the "point cloud" that has been created from the millions of LiDAR points. These points are accurate to within less than an inch relative to another point within that cloud. The assets are then extracted using this extremely precise measuring to arrive at distance measurement. Measurement of height, width, and distance from roadway are taken and added as attributes to each of the assets being collected. The end result is a highly accurate asset database with numerous attributes that allow UDOT to significantly better define what assets they have and how to better manage those assets, thus saving time and money.

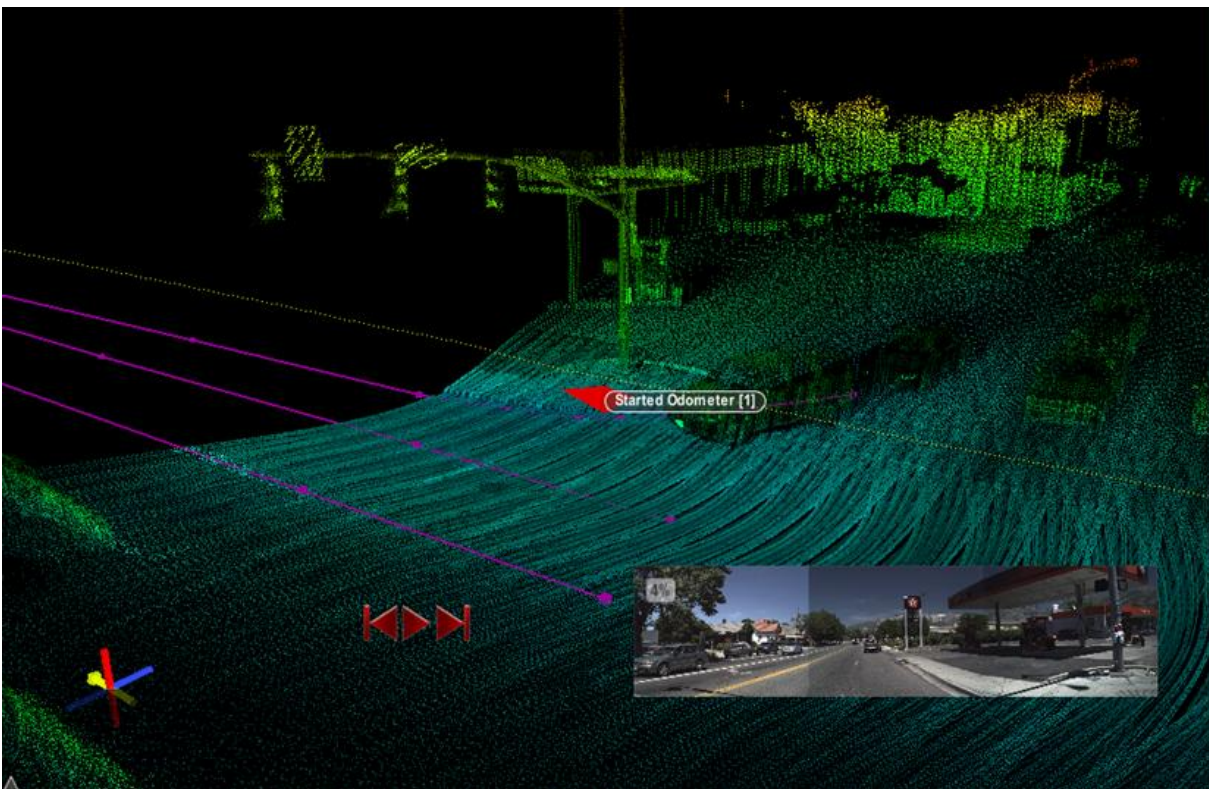
Because of the accuracy of the data being collected, survey grade data can be obtained from the point cloud. This could substantially decrease the amount of surveying that would be needed on a project. Recently I-15 in Salt Lake Valley was surveyed using this method at a cost of \$56,000. Traditional methods employing several survey crews with night time lanes closures could have cost upwards of \$1 million, for a conservative cost saving ratio of 10:1.



In a normal year UDOT is not required to survey such a busy interstate as I-15 in Salt Lake Valley. The Department's average annual survey budget is approximately \$500,000. We conservatively estimate that using the LiDAR Point Cloud could result in a 50% savings or \$250,000 per year.

This effort will eventually incorporate and have an effect on most of the UDOT Divisions. Currently, Region 2 in the Department is using targeted control points along with the LiDAR Point Cloud in order to obtain survey grade data sufficient for design. Region 2 has assisted in surveying new targets on I-15 and I-80 prior to the collection of point cloud data and will design with LiDAR data as part of a pilot project.

Because of the extensive nature of the data that UDOT will be obtaining, the benefits are seemingly limitless. An extensive asset database will allow UDOT to better spend transportation dollars on the areas that need it the most. Drawing correlations between road features and traffic accidents will allow for better planning for safety improvements. Many of the benefits will be fully realized much later in the future as the data is analyzed and applied within UDOT.



Application of Geographic Information Systems

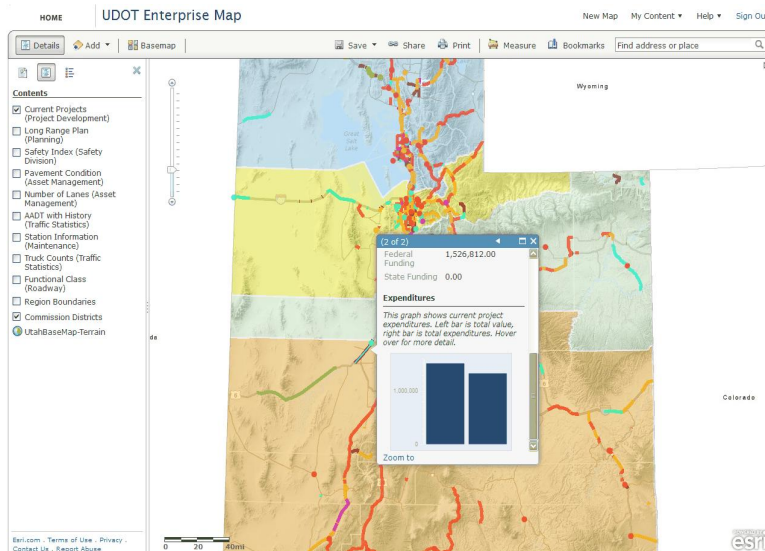
Improving the functional and use of Geographic Information System (GIS) tools has helped the Department become more efficient in using available data sets. Some notable examples are given below.

UPlan GIS Web Application

Savings: Estimated \$300,000 cost savings in fiscal year 2012. .

Efficiency: Improved work flow and data visualization.

UPlan is a highly available web GIS application providing quick and easy access to a wide variety of information. It reduces the turnaround time of focused GIS projects and helps get UDOT data in the hands of users via their desktop computers or mobile devices. A big goal this year is to focus the platform to UDOT needs. Users can now view all interested data together that was once spread across various agencies and UDOT Divisions. By compiling this data spatially, UDOT and other state agencies can establish more positive and productive working relationships, communicate needs, understand issues, and reduce duplication of work, leading to reductions in costs and time requirements, and helping to create better projects with fewer impacts.



Over the last year the Department as a whole saved approximately \$300,000 in costs on various projects by using the UPlan platform. This savings came from using a new vendor-based platform instead of building and maintaining our own system at a higher cost, as well as from saving time by having on-demand data.

The UPlan platform can also be used as a venue for field data collection. The Maintenance Division used the UPlan platform as a tool to do culvert

data collection with their smartphones and tablets. Leveraging the Global Positioning System (GPS) in those devices they were able to access the UPlan platform and edit culvert data locations and conditions while the users were in the field. This made for a very consistent data set and streamlined the data collection workflow. It also saved costs by avoiding an investment in software and/or GPS hardware the Maintenance Division would have needed to do field data collection.

Planning and Environmental Linkage Tool

Savings: Approximately \$100,000.

Efficiency: Reduces person-hour needs by streamlining NEPA data collection and CATEX documentation.

The Planning and Environmental Linkage (uPEL) tool is the Department's approach to satisfying the SAFETEA-LU requirements for state departments of transportation to evaluate the environmental impacts of a project early in a project life cycle. The uPEL tool was developed by using the Department's UPlan GIS application to perform the required environmental analysis screening. During the UDOT environmental process, many reports and analyses are needed to quantify resource impacts. This tool reduces time during projects and the person-hour needs by streamlining the data gathering part of the project for UDOT and potentially for other state agencies. This tool also has the potential to satisfy portions of the environmental clearances needed for the Categorical Exclusion (CATEX) process on many preservation projects. The uPEL tool will also help in streamlining alternative analysis for new construction projects. Additionally, this tool has been a valuable platform for UDOT to engage the resource agencies in future data sharing agreements.

Emerging Area Plan for Uintah Basin

Savings: Approximately \$50,000 in staff costs.

Efficiency: Enabling planners and stakeholders to synchronize local government and state projects.

Completed in early 2012, an Emerging Area Plan for the Uintah Basin was developed using GIS tools and coordination between stakeholders. This effort helped locals and UDOT share project plans in a central location and reduced staff costs associated with coordinating project priorities and construction activities of multiple funding types. Cost savings were realized in an ongoing study to determine the transportation constraints of the energy extraction industry in the Uintah Basin.

I-15 Freight Mobility

Savings: Reduced time to identify and meet a freight mobility need.

Efficiency: Working with highway freight operators and GIS tools to address mobility and safety needs.

Using GIS tools and coordinating with highway freight operators, the Lunt Park Rest Area was identified in the I-15 Freight Mobility Plan to address mobility and safety along the I-15 corridor. The truck parking stalls were then increased by 24 stalls to allow for additional parking opportunities and to address this mobility and safety need.

Trans Tech Program

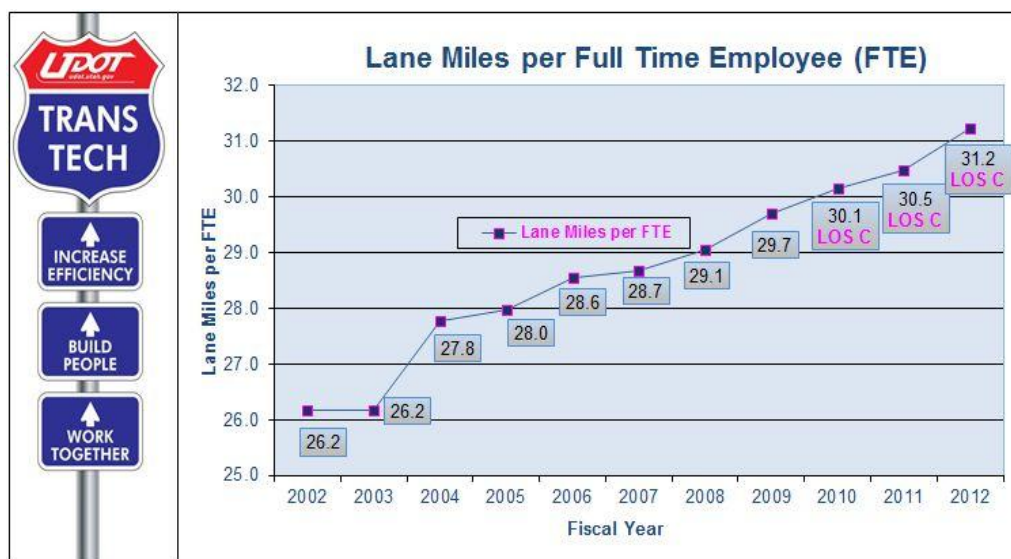
Savings: Approximately \$4 million during fiscal year 2012 from utilizing the same labor force in both maintenance and construction activities.

Efficiency: Increased productivity of the labor force in both maintenance and construction, by optimizing labor throughout the year to match the peak seasons in maintenance and construction.



The Transportation Technician (Trans Tech) Program was implemented years ago to increase the efficiency of the UDOT workforce during the year by sharing the same personnel to work in Construction and Maintenance activities. The Trans Tech Program promotes efficiency of operation. It also encourages career development by allowing employees to become proficient both in managing construction projects and in operating maintenance equipment. The program has successfully empowered transportation technicians with both maintenance and construction skills and, at the same time, it has created substantial operational savings.

The Trans Tech Program also encourages innovation. It gives opportunities to employees to think outside the box and find cost-efficient and innovative ways to perform their jobs. Trans Techs are required to perform the necessary maintenance activities to provide the public the same level of service (measure of congestion) on Utah Highways even when crews are split between construction and maintenance, and in the face of continual increases in lane miles. Consequently, new methods have been created, maintenance routes have been rearranged and optimized, and efforts have been united to accomplish the Department's goals. For example, the graph below shows how the Trans Tech Program helped to provide the same level of service even though the lane-miles per employee have been increasing.



For example, Region One maintenance stations worked together and grouped their mowing equipment resources. By doing this they were able to make one pass on I-15 in each direction, instead of having to make multiple passes and backtrack numerous times, saving time and resources. In fact, Maintenance employees in the Clearfield Station area mowed I-15 in three days, when it used to take two weeks. This lessened the time of exposure to traffic and minimized the traffic impacts and hazard time on the freeway.

In another example, Region One recently re-organized plowable lane miles and plow routes. In doing this, plow routes in I-15 were adjusted to have the Centerville Station plow/sand to Layton Parkway and Clearfield Station to Kaysville, providing some overlap. This also adjusted plow times in each area to more reasonable times (1hr 15min for I-15) which made it more efficient and cost effective. Clearfield, with the I-15 adjustment, acquired I-84 from the Ogden station, which gave Ogden more resources to adjust their plow routes and provide better service in the Ogden area.

The Trans Tech Program promotes efficiency and innovation of the UDOT workforce and creates substantial operational savings. It is anticipated that the program will continue to build successful employees while achieving the Department goals.

Signal Coordination Improvements

Overall Efficiency: Reduced user costs by focusing resources in the areas with the most need and implementing the most effective solutions.

2012 was a year of significant change in UDOT's traffic signal program. Executive Director John Njord's challenge to transition the program to become "World Class" resulted in numerous changes to the organization, processes, resources, and priorities. These changes followed a thorough review of current UDOT practices within the signal program, compared with national best practices and stretch goals established by the Department. As a result, UDOT's transition to a World Class traffic signal program is demonstrated by the following accomplishments during fiscal year 2012.

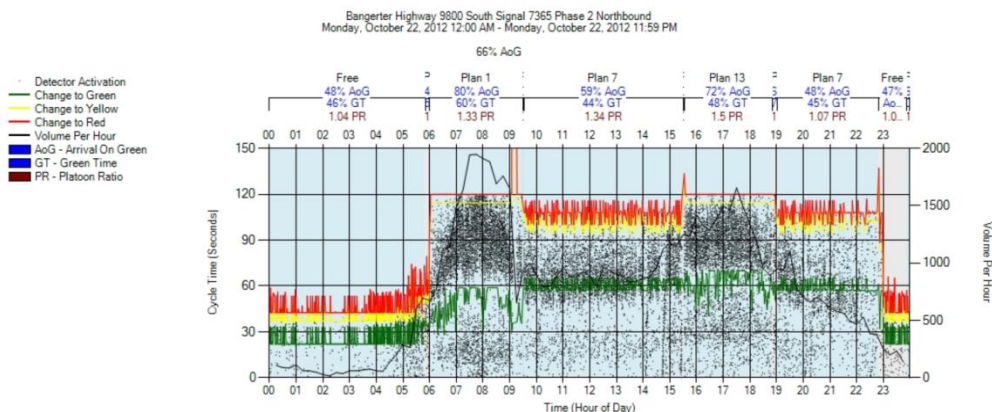


Real-Time Performance Measurement of Traffic Signal Operations

Savings: Estimated \$3 million in reduced user costs in the coming year.

Efficiency: Assess effectiveness of traffic signal timing and coordination plans in real time.

The ability to measure the arrival of vehicles at traffic signals in relation to the red, yellow, and green phases is an exciting new development in UDOT's traffic signal program. This brand new technology will allow UDOT, for the first time, to assess the effectiveness of traffic signal timing and coordination plans in real-time. Resources can then be directed to address the intersections and corridors in the most need of signal timing adjustments. Real-time arterial traffic volumes and speeds are also now available as a result of this innovation. UDOT partnered with Indiana DOT, Purdue University, and Wavetronix (a Utah company) to implement this innovation here in Utah. We are one of only a handful of agencies nationwide with this capability. The initial deployment is at 50 intersections and will expand to 500 over time.

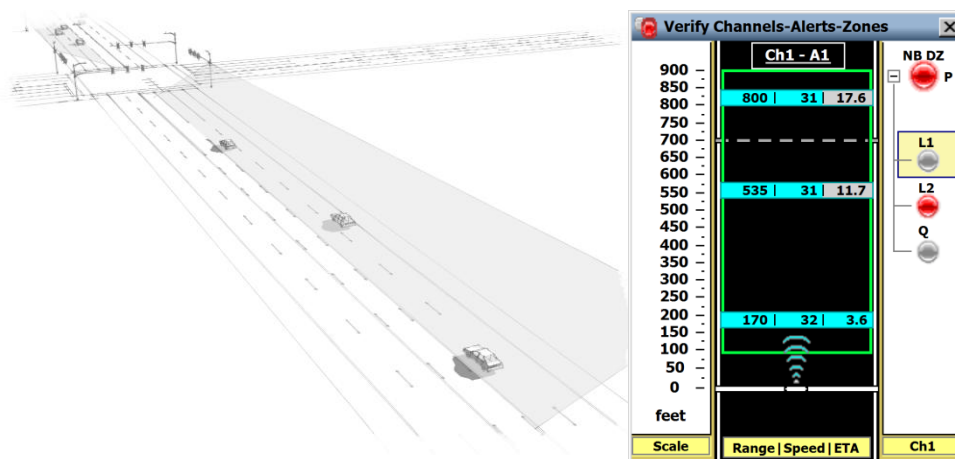


Dynamic Dilemma Zone Detection on High-Speed Corridors

Savings: \$495,000 in user cost safety savings for fiscal year 2012.

Efficiency: Fewer crashes at intersections from adjusting signal timing based on vehicle approach speed.

The dilemma zone is the point where drivers must decide to stop or proceed through an intersection when the light turns yellow. This point changes, depending on the approach speed. New radar units allow approach speeds and vehicle size to be detected up to 900 feet in advance of the signal. The signal then adjusts the signal timing to match the approach speed of vehicles. This is especially effective in reducing red-light-running crashes involving speeding vehicles and large vehicles (trucks), with research showing up to a 54% reduction. This technology is most effective on roads with approach speeds of 40 mph or greater. It was installed at 33 intersections in fiscal year 2012, with a user cost safety savings of \$15,000 per intersection.



Traffic Signal Operations During Large Civic Events

Savings: \$130,000 per BYU football game and \$400,000 per Stadium of Fire event in user cost savings.

Efficiency: Reduced loading and unloading times for those attending large events.

UDOT is expanding its efforts to provide traffic signal operations support for civic events with regional traffic impact. This work includes coordinating with event planners and local jurisdictions, developing traffic signal timing plans, coordinating a public involvement plan, and executing the traffic signal timing and public involvement plans during the event loading and unloading periods. Major events supported now include BYU football and basketball, U of U football and basketball, Sugarhouse fireworks, events at Energy Solutions Arena and at the Maverick Center, LDS General Conference, Layton fireworks, the Freedom Festival's Stadium of Fire, the Hill Air Force Base Air Show, Ragnar Relay, USU football, Dixie State football, Weber State football and basketball, Larry H. Miller Motorsports Park, and others. Results have been dramatic. For example, loading and unloading times for the Stadium of Fire (attended by 200,000+) were reduced from an average of 120+ minutes to 70 minutes. BYU football loading and unloading was reduced from an average of 120+ minutes to 50 minutes.

Corridor Responsive Ramp Metering

Savings: \$170,000 in user cost savings for fiscal year 2012.

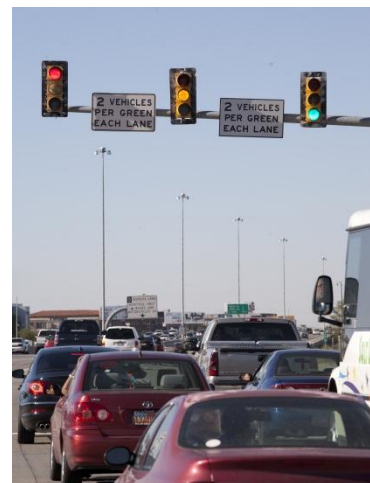
Efficiency: Real-time adjustment of ramp metering rate to provide better traffic flow on ramps and the interstate.

Ramp metering is an effective tool to manage mainline traffic flow on the interstate. The new corridor responsive system monitors traffic volumes on both the ramps and mainline and makes appropriate adjustments to the metering rate in real-time. The current deployment was successfully



demonstrated on southbound I-15 from 3300 S to 9000 S, and on northbound I-15 from 12300 S to 7200 S. As a result, during peak traffic periods

mainline speeds in the general purpose lanes increased by an average of 18% in these segments, and volume in the general purpose lanes increased by 8%.



ACS Lite Traffic Adaptive Signal System in Heber City

Savings: \$310,000 in user cost savings for fiscal year 2012.

Efficiency: Reduced delay and travel time by allowing signal systems to adapt to traffic demands.

Traffic adaptive signal systems allow signal timing to be automatically adjusted in real-time, in response to current traffic demands. The Heber ACS Lite system is the second such system in Utah, joining the current Park City SCATS system. The Heber ACS Lite system has reduced daily average delay on Heber Main Street (US-40) by 30% and decreased corridor travel time by 6%.

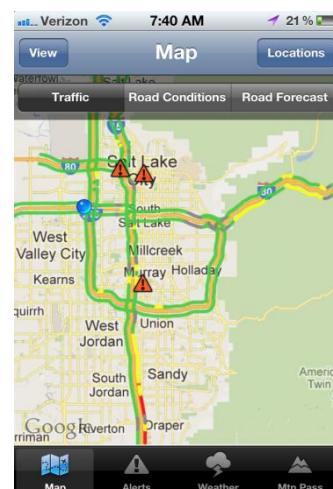
Traveler Information Tools

Savings: Timely access to traveler information helps drivers minimize delay.

Efficiency: By communicating directly with mobile devices, UDOT is providing its customers with instant, convenient access to UDOT Traffic traveler information.

One of UDOT's primary goals for the Automated Traffic Management System (ATMS) is to provide useful and timely traveler information. Effective traveler information facilitates informed decisions by drivers and allows UDOT to be more effective in managing traffic. Social media and the proliferation of the smartphone are changing the way people access and collect information. In response, UDOT created the UDOT Traffic smartphone application and established the UDOT Traffic Twitter account.

The UDOT Traffic "app" provides our customers with mobile, instant access to statewide traveler information including camera images, emergency alerts, crash alerts, congestion maps, weather data, road condition forecasts, electronic sign messages, and construction alerts. The app contains all traveler information available through the UDOT Traffic Website and the 511 phone system. The app has been downloaded nearly 85,000 times through October 2012. We estimate that roughly 20% of Utahns with an Android or Apple smartphone have downloaded the UDOT Traffic App.



The ability to push traveler information to our customers is key to providing instant access to latest traveler information. Recognizing this, the UDOT Traffic Twitter account was established. The account averages 7 tweets per day, and we add about 4 new followers per day. Through October 2012, there were 2900 followers, many of which are local media. This is significant because during major events we regularly reach close to 100,000 Twitter users through re-tweets.



Templates For Work Processes

The Department continues to streamline processes internally and with external partners. Some of the key changes and their benefits, involving improved process templates, are highlighted below.

Adapting To New Power Service Format Required By Rocky Mountain Power

Savings: Actual \$ unknown, but in scheduling utility action and cooperation it has been effective.

Efficiency: Utility Company's cooperation with projects including meetings, scheduling, coordination and prioritization have improved.



When UDOT calls in a power service request (power service needed for a new signal, sign, lights etc.), it can be called into Rocky Mountain Power as many as two years prior to when the power service installation is actually required. The time delay causes the power company to lose track of the Department's projects and makes them wonder if UDOT projects have been delayed, dropped or stopped. This time delay is an average of two years and it occurs as the project design is completed, contractors are selected and the majority of a project is built. Near the end of the project Rocky Mountain Power is occasionally called to hook up its power supply. Without project involvement and constant updates Rocky Mountain Power does not know when the power is needed and so they attempt to squeeze UDOT's needs into an already overbooked workload. Last minute rushes and crunch times were the typical of the way things were getting done.

Working with the Department's comptroller office, UDOT Region Two preconstruction and construction staff has consolidated a new process that locks in power supply estimate amounts for delayed projects and ensures Rocky Mountain Power of UDOT's project intentions. UDOT Region Two staff now prepares agreements soon after receiving estimates from the power company. Other UDOT staff request a physical check payment from the Comptroller's office which is delivered to UDOT's Preconstruction Utilities Office. The check and the executed agreement are then hand delivered to the estimators at Rocky Mountain Power. Since the up-front money is accepted by Rocky Mountain Power, their work is essentially paid in advance and does not need to be paid for by UDOT's Resident Engineers at a non-inflated or changed cost to the Department. Power service agreements that are paid for up front are not as easily misplaced or forgotten in the utility company's programming system.

Efficiency of the new process is a side benefit that includes the knowledge that Rocky Mountain Power has accepted money for requested performance. Rocky Mountain Power knows that if UDOT has paid in advance then the work will eventually need to be performed and so it stays on their prioritized work list. Also prices are basically set at the point when they received the money. If construction prices fluctuate it is Rocky Mountain Power's responsibility to do the work regardless. Lastly, the utility company is

happier which makes their relationship with the Department stronger and makes it easier to resolve problems as they arise.

Using Projectwise To Streamline Right Of Way Document Reviews

Savings: Over 500 person hours saved during fiscal year 2012.

Efficiency: Right of Way document review times have been reduced by utilizing electronic file systems and processes.

The Department's Region Two Right of Way Division has used Projectwise database software to streamline review processes and improve efficiency. Implementation of Projectwise has facilitated a central electronic file location for all entities to have access. It provides quick access to the files and information necessary for right of way property acquisitions. Region Two Right of Way is responsible for review of consultant prepared drawings, map files, and associated documents. After the Region review has occurred, Central Right of Way can begin the acquisitions process. Having all of the files in one central, electronically accessible location improves the process due to the easy ability to make any needed changes.



The Projectwise system is used to facilitate and track the work flow. Projectwise has provided the ability to log all actions taken on individual right of way documents, providing a more accurate reflection as to where the deliverable is in the process. Tracking changes to documents has been more effective and easy to manage with Projectwise, rather than monitoring and logging transmittal letters. The current status of the document is always known.

Projectwise has also eliminated the need for hard copy deliveries saving time and resources. Right of Way acquisition is typically the critical path activity during the project development process, so time saved during right of way activities is a net benefit for the entire project. Previously, multiple hard copies would be printed and hand delivered for each step of the process. If corrections were needed, the changes would be mailed back and new hard copies would be produced and delivered. Using electronic files has saved production and delivery costs. Time savings are a result of project team members no longer having to wait for documents to be mailed or hand delivered as they are now instantly available.

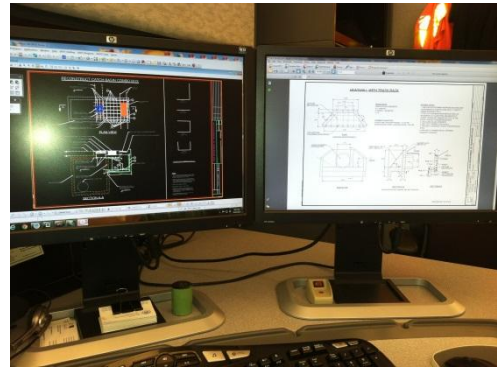
Right of Way information management and collaboration for transportation projects is full of unique challenges. Utilizing Projectwise has improved the quality, efficiency and accessibility of the of right of way information for project teams.

Templates For Preconstruction Work Processes

Savings: \$15,000 annual savings.

Efficiency: Reduced time spent on design has resulted in quicker project delivery.

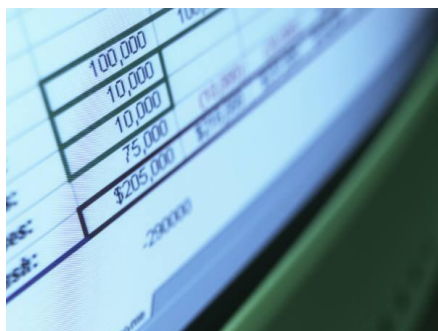
The Department's Region Two Hydraulics and Design staff has created detail drawings, project forms, meeting attendance, and calculation sheets that are regularly used on projects. These drawings and templates minimize repetitious work and increase consistency from project to project.



Hydraulics staff created detail drawings for many of the commonly used drainage features that are not in the standard drawings. These detail drawings are commonly used on almost every drainage design project. Drop Inlet, Collar Connection, Abandon Catch Basin, Combo Box with No Manhole, and Headwalls are just a few examples of the detail drawings that have been created. Designers do not have to recreate these details for every project which saves design and drawing costs. These details can also be utilized on non-projects to assist maintenance with their needs. Region Two can easily share these details with other UDOT Regions and Consultants, reducing costs and streamlining drainage plan sheet production.

Roadway Design staff have also created templates and calculation sheets for many of the milestone meetings that occur during the project development process. A master Milestone Meeting and Plan Distribution Memo template has been created with current Region personnel to reduce time researching the names and titles for those who are invited to the meeting and receiving a plan set for review.

A Master Comment Resolution form has been created that compiles the comments for the Scoping, Geometry Review, Plan in Hand, and Plans/Specifications & Estimates meetings into one file. Having one form with all the comments reduces the number of files and simplifies the advertising process. It also makes it quicker to refer back to previous stages of the project to see how similar comments were addressed.



Basic calculation sheets have been created for use on pavement preservation projects to aid in documenting how quantities were calculated. Using a standard form for quantities makes the design and quality check process faster because the information is created and documented in a consistent uniform manner.

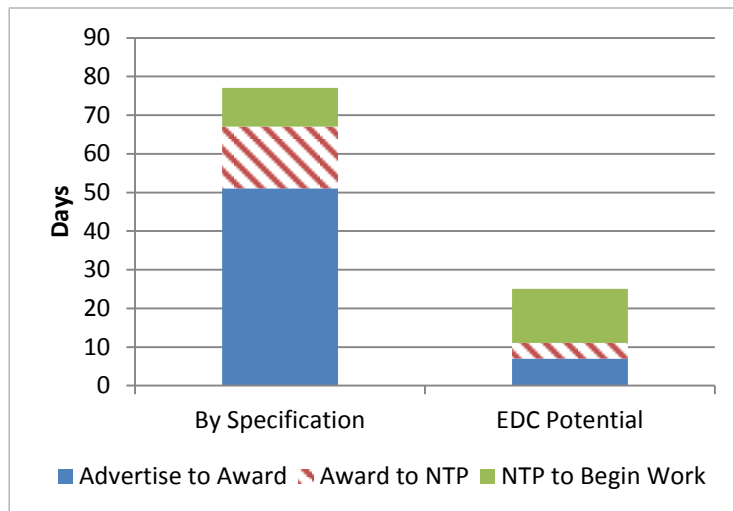
All of these time saving efforts are reducing the time projects are in design so that the project can be built faster, benefiting the public.

Expedited Delivery Contracting

Savings: First project estimates a 30% reduction in Preconstruction Engineering costs.

Efficiency: 68% reduction in time between advertising and beginning of construction (77 days to 25 days).

The purpose of Expedited Delivery Contracting (EDC) is to reduce administrative work and speed up project delivery. EDC is suited for small repetitive projects which currently take as much administrative effort to acquire a contractor as a large highway project. The EDC program streamlines the design preparation process, and utilizes pre-approved contractors to bid competitively on small projects.



The EDC Program reduces the effort in Preconstruction Engineering services (PE) by streamlining the review process prior to advertising. Instead of having traditional design review meetings at each design stage, the review process is limited to key personnel. The project scope is defined by the design team in a design kickoff meeting with the project sponsors. The final design is reviewed internally by the design team and a third party registered professional engineer. Preliminary estimates suggest approximately a 30% reduction of PE costs.

Reduction of time between Advertising and Construction is also reduced. However, because of its new process the first project did not obtain its full potential. The first project showed a 27% reduction in the time between Advertising and Construction. However, the potential of the current procedure will achieve a 68% reduction in time (from 77 days to 25 days, see the Figure above). Comparisons are based on limits presented in the Standard Specifications.

The current process is under negotiation with the FHWA through their SEP-14 Process. Evaluation of the performance of the first construction season has suggested that the EDC process be modified. The recommended changes are being prepared for review by the FHWA SEP-14 process. Additional Safe Routes to School sidewalk projects will be delivered via EDC next year.

Motor Carrier Division Business Systems Improvements

Savings: Improvements in electronic submission of citations to the courts provide approximately \$900 in annual savings Division-wide.

Efficiency: Eliminated errors in the misinterpretation of hand written records and in the delivery of these hand written records to the courts.

System modifications and data improvements were required to comply with the State mandate for electronic submission of citations to the Department of Public Safety through the courts. Improvements to the Department's Motor Carrier Division's On-Line System (MCOLS) were made to meet this requirement.

Assumptions:

- 4% or 3 in 75 citations issued require some sort of clarification each month.
- There are approximately 250 citations issued per month by the Division.
- Each of these interactions requires an investment of approximately 30 minutes for clarification.
- The average wage of a port of entry employee is \$15.00 per hour.

The electronic submission of citations is a more efficient method of providing citation information than hand written records, taking away human error in the reading/interpreting someone else's writing. There are also efficiencies in electronic submission rather than the delivery of these hands written records to the courts.

Repetitive Utility Agreement Templates

Savings: 10 days duration (average) saved and 4 to 6 person hours (average) saved in creating and executing agreements.

Efficiency: Faster preparation and processing of repetitive agreements.

In order to facilitate the creation and execution of repetitive agreements, the Department's Region One Utilities Group has created seven different agreement templates that have been reviewed and approved for use by the Assistant Attorney General assigned to the Department. These agreements are in a "fill in the blank" format and have reduced the amount of coordination required in-house to complete and execute these agreements. Templates created include: Adopt-A-Highway agreements, litter cleanup agreements, park and ride facilities maintenance agreements, school zone crosswalk agreements, landscape agreements, cooperative agreements, and letter agreements.

It has been the experience of the Region One Utilities Group that the internal coordination required to execute the types of agreements listed above is an extensive and time consuming proposition. These agreements generally took over two months of coordination and communication with project managers and 8 to 12 person hours to complete. After the completion of these templates, a project manager asked that a cooperative agreement be drafted. The agreement was reviewed and sent for execution within the hour. The total man hours required for this agreement was 1 hour. Typical time savings from using the new templates has been an average of 10 days (16%) less in the process duration and 4 to 6 person hours (50%) less expended.

Innovative Contract Management

The Department has implemented several innovative approaches to initiating and managing construction contracts. These efforts, some of which are highlighted below, have provided cost savings to both the Department and the public. Four of the innovative approaches described below come from the I-15 CORE Project in Utah County, as indicated.

Change Order Review

Savings: Implementation of the recommendation to have additional support and an independent review of all change order cost information has saved over \$400,000 this construction season.

Efficiency: Other recommendations are expected to save time and money in administration of the change order process.

This past year UDOT commissioned Moss Adams, a nationally recognized accounting firm with a specialty in construction accounting, to review UDOT's change order process and recommend process improvements. Overall, the review determined that UDOT has good change order policies, but determined that several of the recommendations of the report would lead to cost savings and efficiencies in the process. The major recommendations are described below:

Implementing a small value change process could reduce processing effort for 41 percent of the change orders reviewed. The Resident Engineer (RE) should be allowed to process contract changes up to a cumulative value of \$25,000 for each project (consider a greater amount on larger projects). These could be given a separate designation: Arizona calls its small changes "Letters of Agreement," Colorado calls them "Minor Contract Revisions."

Include Preemptive Language for Common Repairs in All Contracts. UDOT contracting policy should be modified to consistently identify and include preemptive language for common project repairs or similar costs in future contracts. Establish rates for repair work, approvals and maximum charges for each specified work scope.

Increase Emphasis on Planning to Avoid Design Errors.

- Review and modify current UDOT policies as needed, as well as provide training. Encourage value engineering/risk assessments on high risk projects
- Site survey by the Design Engineer.
- A checklist to ensure these and other required planning tasks are completed and signed off by the performer.
- A control to ensure all checklist items is properly completed.
- Evaluate setting conditions and thresholds (such as \$25,000) that will result in the cost of errors and omissions for outside engineers to be charged back to the outside engineer if the work is considered to be negligent.

Utilize the Form C107 Process as a Notice to Proceed and Allow 30 Days for Pricing Approval. Form C107 should be utilized as a “Notice to Proceed” (rather than an “Emergency Authorization”). Specify maximum charges as well as audit rights and indicate allowable and allocable charges that may be applied to each C107. Maximum amounts should be established for C107 forms that require additional documentation and approvals needed to protect UDOT from non-compliant and/or excessive change order costs. This provides the Resident Engineer or Project Manager a process to authorize the work with the general contractor without a cost commitment. Allow additional time for the pricing to be completed. Allow 30 working days, and if pricing is not agreed upon as evidenced by the completed Form C100 at the end of 30 days, consider using the Force Account process which is already in place.

Provide a Template that Reconciles Cost Support to the Change Order Value and Cost Support

Training. The cost support documentation should be a “top-down” process. After including the Form C100 and Letter of Explanation documents in the change order package, an Excel spreadsheet template should be included that identifies the cost support documents and sums the totals of unit prices multiplied by quantity. This amount should reconcile to the total value of the change order. Clearly identifying the change order cost support and reconciling to the total change order value should provide for quicker comprehension of the change order and help ensure all required supporting documents have been provided. Support should be provided for all elements of cost, work requirements to be applied and completeness of deduct pricing specified. Additional training regarding the UDOT policy and proper supporting documents at the RE level is recommended.

UDOT plans to implement all of these recommendations to ensure that every effort is being made to improve the process.

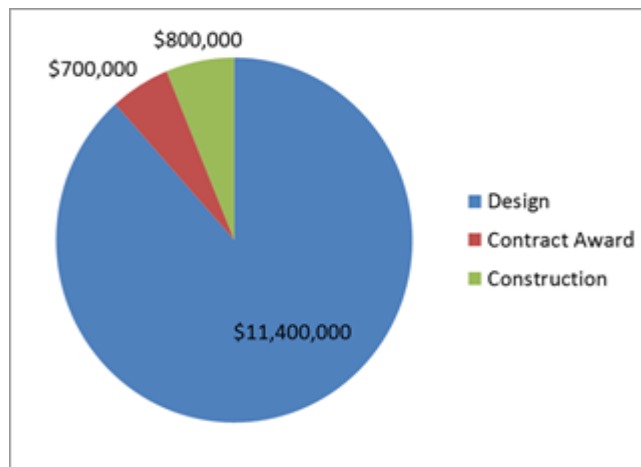
Cost Based Estimating

Savings: \$12.9 million in fiscal year 2012.

Efficiency: Adding contractor experience to UDOT project delivery teams helps save costs and smooth out project delivery.

The Department has seen huge benefits from using cost based estimating. In this process, former contractors support Region project teams during design, contract award, and construction. This additional perspective saves money and helps deliver projects more smoothly. Major efficiencies from this process include:

1. Improving designs to reduce change orders and risk to UDOT.
2. Conducting bid award reviews to identify potentially costly and risky bids.



Breakdown of the \$12.9 million in cost savings for efficiencies noted.

3. Helping construction personnel negotiate fair market costs for change orders.

A few projects where cost based estimating has yielded significant cost savings are listed below:

- Region 1. Change order review on *I-84; Mountain Green to Morgan*. Assisted UDOT resident engineer with change order review. Cost savings: \$59,000 from the change order reduction.
- Region 2. High confidence cost estimate on *5400 South; Bangerter Highway to 4800 West*. Worked with project team to modify project from shoulder widening to a needed full reconstruction, which eliminated need for reconstruction in 2015 as previously planned. Cost savings: \$7 million from project technical changes and not delaying the reconstruction until 2015.
- Region 3. Bid award review on *US-40; Vernal Main Street to Naples*. Original bid was high. Worked with project team to revise time constraints and incentives and then re-advertise. Cost savings: \$550,000 from the difference between the original bid and the final winning bid.
- Region 4. *SR-14 Landslide Emergency Repair CMGC*. Worked with project team to identify extraneous contractor profit and overhead costs and negotiate with contractor. Cost savings: \$700,000 from negotiating submitted profit and overhead costs to the original level proposed.

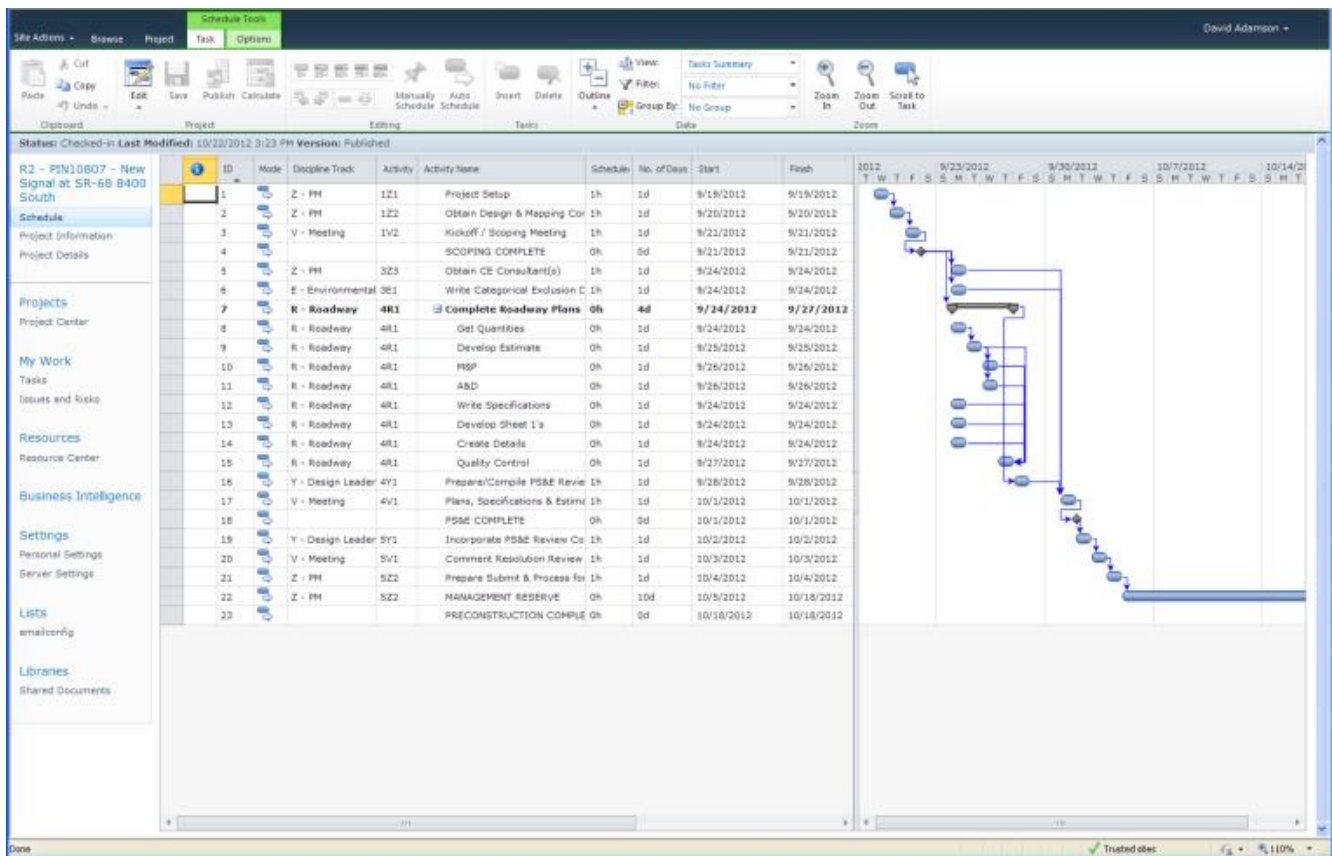
Project Scheduling System with a Business System Interface

Savings: Estimated savings of more than \$150,000 in fiscal year 2013 based on the inflation cost of the construction delays.

Efficiency: Assists projects to meet the committed construction advertise date, minimize project design delays, and continue to capture valuable historical schedule information, trends and measures.

UDOT is changing the way that we track and manage project schedules. Historically, we have used the Multiple Project Scheduler (MPS) in the Electronic Program Management (EPM) system for project schedule management, but it has not been effective because it took schedule management control away from the project teams and managers.

The Department has purchased and is implementing Microsoft (MS) Project Enterprise along with MS SharePoint. These tools will replace the project schedule component in ePM. This MS Project Enterprise program will allow us to store all project schedules on a common server thereby allowing functional managers to manage their resources. Also, key project data will link back to ePM for reports and program management. MS SharePoint will assist project teams with communication during project schedule creation and updating. The MS Project Enterprise tool will help Project Managers develop realistic schedules and also manage and maintain those schedules throughout preconstruction. This will improve Project Delivery by helping Project Managers identify and resolve project delaying issues. This will result in advertising more projects on time which allows construction during the intended season. A project delay to the next construction season has real inflation costs. A conservative estimate of fiscal year 2013 savings is \$150,000 based on UDOT's program of at least \$300 million per year, advertising 5% of projects one season earlier, and current inflation of 1%.



Screen shot of Project Web Application (PWA)

Project Level Risk Management Initiative

Savings: \$7 million on the SR-14 Landslide Repair Project.

Efficiency: The Department has begun implementing a Project Level Risk Management process on many of its projects to eliminate, minimize, or assign risks and save project costs. The goal is to have this process used on all projects by the end of fiscal year 2014.

Project Level Risk Management is a formal process which, by using specialized tools, identifies risks to a project and quantifies the magnitude of each risk. By comparing the relative magnitude of risks the project team can focus their efforts on the most significant ones. Mitigation strategies are then developed, implemented, and tracked in an effort to eliminate, minimize, or correctly assign risks.

The SR-14 Landslide Repair Emergency project was one of the first



projects in the state to follow the process all the way through Environmental, Design, and Construction phases. This project was unique because the compressed schedule allowed the Department to quickly evaluate how the process worked.

Because the Department used the Construction Manager / General Contractor (CMGC) contracting method, it had the construction contractor on board during the design process. The contractor's participation allowed identification of risks that are not normally considered during design. Items such as: equipment availability, staging areas, construction phasing, and site access were particularly important during this fast-tracked project.

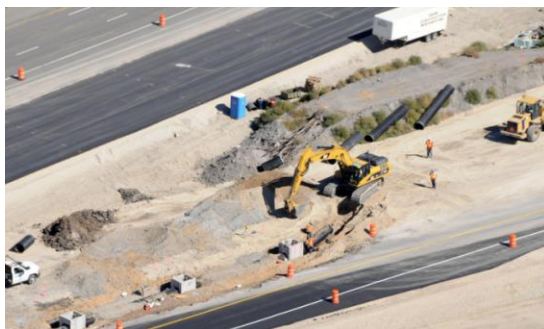
The Department's design consultant (Parsons Brinkerhoff) developed an initial design while the contractor was being hired. Once on board, the contractor (Kiewit) provided a bid on the initial package. This bid was approximately \$21 million. The Department then performed a formal Risk Analysis which identified those elements which were contributing the most cost risk to the project. By focusing our design effort on those elements we were able to refine the design to lower the contractor's risk and therefore his costs. In the end the total cost of the project was approximately \$14 million. This represents a decrease in cost of approximately \$7 million. Most of this savings can be directly attributed to the combination of Risk Analysis with the CMGC process.

Effective Utility Location and Identification Process

Savings: One-time savings of \$10 to 12 million on the I-15 CORE Project.

Efficiency: Subsurface Utility Engineering investigation resulted in design and construction cost savings through managing risk from utilities.

The Department had significant savings in the I-15 Corridor Expansion (I-15 CORE) Project in Utah County. This process description is the first of four processes, included in this portion of the report, which contributed to those savings due to innovative contract management.



The inability to obtain reliable underground utility information has long been a troublesome problem for highway designers. Realizing this problem, the Department made great efforts to provide essential utility information to each Design-Build Team selected to submit a proposal for the I-15 CORE Project. An engineering practice known as Subsurface Utility Engineering (SUE) was performed throughout the I-15 CORE Project limits. The SUE process combined civil engineering, surveying, and geophysics. It utilized several technologies, including vacuum excavation and surface geophysics.

Through the use of the SUE process, risks associated with utilities were managed and project cost savings were achieved on the order of \$10 to 12 million on the I-15 CORE Project. The following benefits generated project cost savings:

- Unnecessary utility relocations were avoided because accurate utility information was available to the highway designers early in the development of the project to design around many potential conflicts. This significantly reduced the number of costly relocations, and reduced delays to the project associated with waiting for utility work to be completed before highway construction could begin.
- Unexpected conflicts with utilities were reduced in number. The exact location of nearly all utilities were determined and accurately shown on the construction plans. As a result:
 - Delays caused by redesign, when construction could not follow the original design due to utility conflicts, were reduced.
 - Construction delays caused by cutting, damaging, or discovering unidentified utility lines were reduced.
 - Contractor claims for delays and construction costs resulting from unexpected encounters with utilities were reduced.
- Safety was enhanced. Excavation and grading work was shifted away from existing utilities, which resulted in less damage to utilities and decreased the potential for accidents which could have resulted in personal injury and/or property damage.

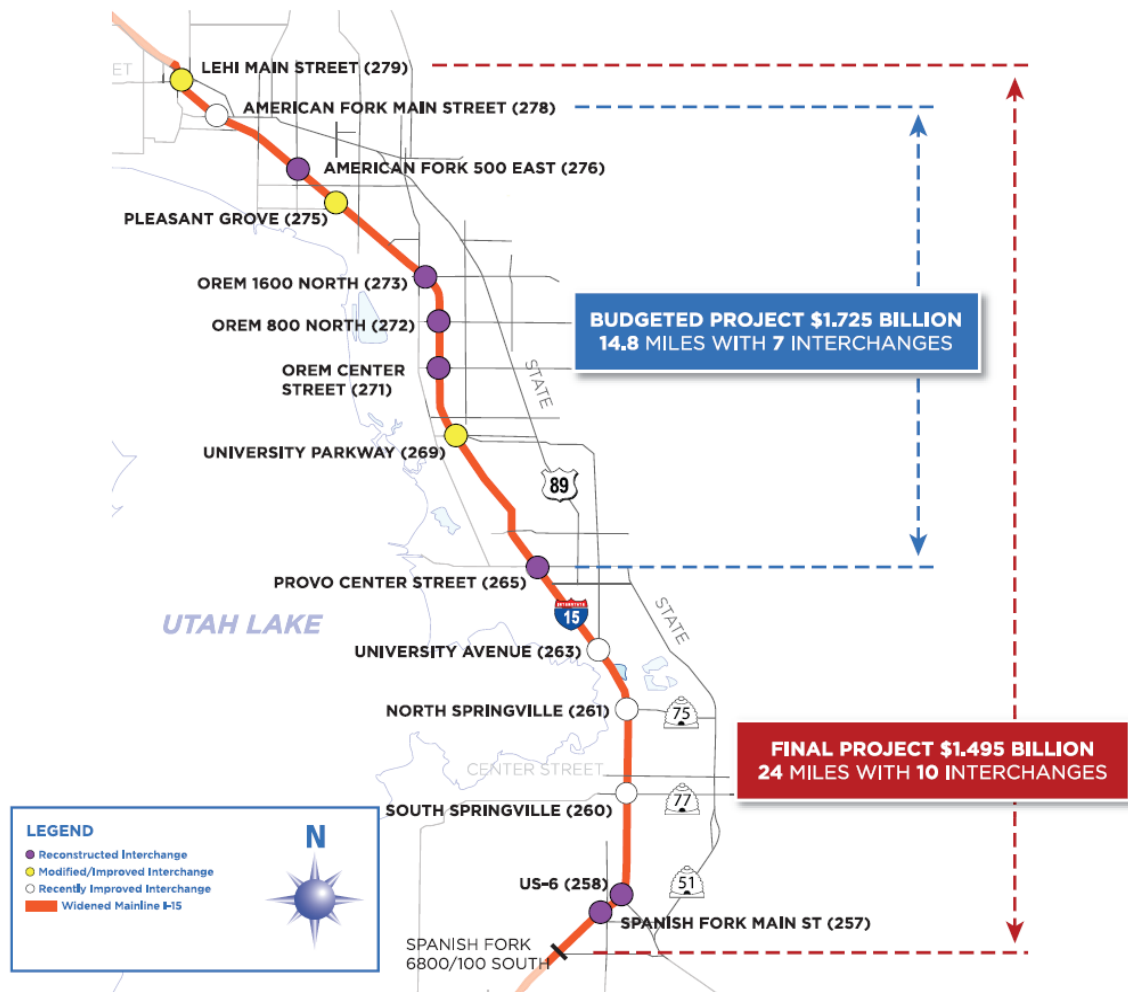
The Department implemented four SUE “Quality Levels” for each identified utility within the I-15 CORE corridor. Quality Levels establish the degree of risk, or how much information is known about a certain utility. The use of quality levels allowed the Department to decide based upon the gathered information what level of risk would be applied to the Department by certifying that a certain level of accuracy and comprehensiveness was provided in the Project Utility Plans.

Maximized Value Through Fixed Price, Base Design Procurement

Savings: One-time savings of \$125 to 150 million on the I-15 CORE Project.

Efficiency: Created a competitive and innovative environment that resulted in an increased value for the fixed price on the I-15 CORE Project.

The innovative fixed-price, best-design procurement used for the I-15 CORE Project in Utah County established a unique competitive environment to provide the highest value to the Department. The method resulted in a project that expanded the initial scope from 14 to 24 miles of reconstructed interstate, maintained the existing travel lanes for the majority of the construction schedule, and shortened the schedule by two years.



The original need for the project encompassed 43 miles; however, funding limitations and subsequent reductions constrained the projected scope to about 14 miles. To achieve the broadest scope possible with the reduced budget, UDOT decided to use a two-phase, shortlisted fixed-price, best-design procurement approach. This was the first time this style of design-build procurement was used in Utah for a public transportation project and the second time in the United States.

Fixed-price, best-design is a variation of a design/build contract. The price was fixed at \$1.1 billion, and the proposers were given minimum requirements and project objectives to guide them as they prepared their proposals. The contracting method encouraged the proposers to innovate in a number of ways (e.g. accelerated bridge construction, construction phasing that maintains existing lanes, minimizing full interchange closures, etc.) to provide a scope and schedule that provided the highest value to the state of Utah.

The Owner team conducted extensive outreach to the construction industry to develop functional and performance-based requirements that allowed the contracting team the flexibility to be creative in developing construction solutions to exceed UDOT's goals and objectives. During the procurement phase, the Owner team met with each of the three proposing teams every week. These four-hour

meetings were used to review initial designs, clarify UDOT values, answer questions, reduce risk and generally improve the quality of proposals.

The proposal process created a highly competitive environment in which proposers had to create innovative and cost-saving solutions. The winning bidder, Provo River Constructors (PRC), was able to save enough money to include a maintenance proposal, which UDOT then chose to not use, and directly saved \$49 million.

The schedule requirement in the request-for-proposals (RFP) stated that the project is complete by fall 2014 and PRC proposed a schedule that completes the project by December 2012, nearly two years earlier than the requirement. I-15 CORE will be the fastest constructed billion-dollar, publicly funded highway project in the history of U.S. road construction.

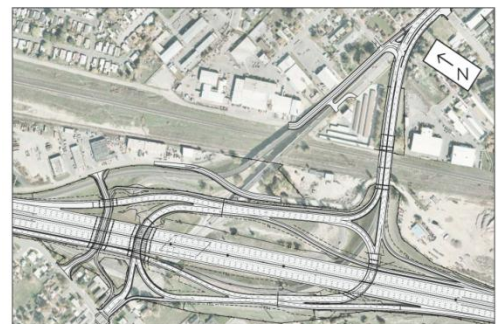
Another objective of the contract was to minimize inconvenience to the public. This required each proposer to commit to the number of days of lane closures. By minimizing the number of closures, the interstate could be rebuilt with minimal impact to the traveling public. PRC proposed about half the allowable lane closures and then only used 60 percent of those, significantly reducing inconvenience to the public. Also, PRC completed 90 percent of lane closures at night when traffic is the lightest.

Effective Risk Mitigation and Change Order Management Process

Savings: Estimated \$45 to 50 million on the I-15 CORE Project.

Efficiency: Reduced project construction cost and accelerated project delivery.

The I-15 CORE team methodically approached the Design-Build procurement and execution of the Design-Build Project which resulted in the completion of I-15 CORE in Utah County two years ahead of the Department's anticipated completion date. This also resulted in less than two percent of the contract value in change orders, versus the industry average for similarly sized projects of five to six percent.



The Design-Builder's original Provo Center Street interchange design

The successful project delivery of I-15 CORE began with the in-depth development and definition of project goals and values consistent with a fixed-price, best-design procurement method.

A robust and thorough risk analysis process was implemented which was guided by the developed goals and values. The analysis process included two Cost Estimate Validation Process (CEVP) sessions. The identification of risks and the development of effective risk mitigation strategies months prior to the release of the RFP allowed time to implement the mitigation strategies to either eliminate or minimize the magnitude of each risk or develop a strategy to assign future mitigation of the risk to the Department, the Design-Builder or the affected Third Party(s), whichever party was best able to mitigate



The Provo Center Street interchange design after a no-cost change order

the risk. The assignment of risks were carefully identified and assigned in the RFP and in the various Third Party Agreements. Two significant risks that the Department spent considerable time and money mitigating were Right of Way and Utilities. These mitigation strategies are described in other sections of this 2012 Efficiencies Report. Not only did this risk mitigation process reduce change orders, effective risk reduction and allocation reduced the percentage of the contract amount that each proposer allocated towards mitigating their own risk and resulted in more project budget being applied to construct more infrastructure.

In addition to allocating risks between the Department and the Design-Builder and establishing the instances when the Design-Builder would or would not be eligible for a change, the RFP established strict time limitations and processes which the Design-Builder was required to stay within to remain eligible to assert a claim for time or money. This process included the requirements to submit a Potential Change Order Notice (PCON) within 10 days after the Design-Builder first discovered the occurrence, and then within 30 days of submitting the PCON, submit a Request for Change Order (RCO). In this manner, issues were identified quickly and brought to the attention of the Department. This process required that if there was not enough information available to submit an RCO within the 30 day timeframe that the Design-Builder could submit an incomplete RCO and provide monthly status updates. Often, if the Design-Builder was unable to submit the RCO within the 30 day timeframe, the Design-Builder would coordinate with the Department and request an extension to the 30 day timeframe. The short time limits to submit PCONs restricted the possibility of a time claim being brought up after work associated with a change was already completed. Continual progression and monitoring of PCONs, RCOs and Change Orders promoted the prompt resolution of issues and prevented pending Change Orders from aging and potentially becoming more costly in both dollars and relations between the Department and the Design-Builder.

As part of the Change Order management process, the Department employed a construction estimator, who had significant experience working in construction as a contractor. Rather than just using unit bid price history to estimate the cost of Change Orders, the construction estimator used the same methods to establish construction cost estimates as the Design-Builder and was therefore able to discuss Change Order costs using the same terminology and vantage point as the Design-Builder. This ability to negotiate Change Orders “toe to toe” with the Design-Builder saved the Department millions of dollars in Change Order costs.

As experienced on I-15 CORE, effective risk and Change Order management significantly reduces Change Orders and the potential for time delays allowing more infrastructure improvements to be provided for a given budget and delivering these improvements sooner and with less disruption to the traveling public.

Effective Right-of-Way Identification Process

Savings: One-time savings of \$15 million on the I-15 CORE Project.

Efficiency: Early Right-of-Way negotiation and delivery resulted in less project delay and cost.

For the I-15 CORE project in Utah County, Right-of-Way (ROW) purchase acquisition posed some of the greatest delay risks to the Department. Experience has shown that allowing sufficient time for proper acquisition, documentation, appraisals, and negotiation is critical to the success of a project. The process of identifying ROW needs including, partial takings, commercial properties, damaged property, utility relocations, court costs, and other ROW-related items is difficult especially for a Design-Build project. Allowing Design-Build teams the freedom to be innovative in their design concepts and maintain reasonable ROW needs creates unique challenges to the Department.

One of the goals of the I-15 CORE ROW acquisition team was to acquire real property identified for purchase in a timely manner to avoid project construction delays and potential project delay claims. It was determined that the ROW team would work closely with the highway designers to identify project ROW needs during the Procurement Development phase of the project. Identifying ROW impacts at this early stage of the project allowed ROW agents an early start to develop ROW documents, negotiate and ultimately acquire the property. One of the strategies implemented with ROW purchase for the project was at completion of the conceptual design all ROW impacts were identified based upon that design. From the identified ROW impacts the Department then established a Project Work limit or boundary that was provided to each bidding Design-Build team. By Contract the successful Design-Build team was then required to design and construct within the provided boundary. In the event that the Design-Builder chose to go outside of the ROW boundary provided by UDOT then the Design-Builder was responsible for the purchase cost of new identified ROW. If the required improvements could not be accommodated within the ROW provided, the Department paid for the ROW. The ROW team worked closely with the design/build team designers during the final project design to further refine and sometimes eliminate ROW impacts. The following benefits resulted:

- Project ROW needs were identified early.
- Department ROW agents could prioritize acquisition efforts.
- Department could provide ROW delivery dates to the Design-Build team.
- Department provided 287 parcels without any project delays (see Right-of-Way Summary below).

I-15 CORE Right-of-Way Summary

	Relocations	Condemnations	Bill Boards	Total Takes	Partial Takes	Easements	Total Ownerships
Residential Parcels	16	5	0	16	26	24	52
Commercial Parcels	21	33	4	24	121	158	167
Vacant Lands	3	6	11	4	19	18	26
Design- Builder Parcels	0	1	0	1	6	8	9
Totals	40	45	15	45	172	208	254

Snow Removal Innovations

Savings: Innovative snow removal efficiencies present cost operational savings of \$124,000 per year.

Efficiency: The implementation of slurry spreaders, gravity flow brine tanks, and the installation of snow fences enhance road safety and accessibility and reduce snow removal expenses.

The First Response slurry spreader maximizes the efficiency in salt usage, reducing the amount of salt by 30%. Salt and brine are mixed together in the spreader and then uniformly dispersed on the road surface. This process allows more material to stay on the road reducing salt usage per lane-mile. The First Response slurry spreader is an environmentally friendly initiative. It applies the right amount of material decreasing the amount of waste. This initiative showed savings of \$24,000 in 2012.



Other methods employed by UDOT Regions are the installation of snow fences and the implementation of gravity flow brine tanks. The execution of these methods is expected to reduce costs by \$100,000 per year. The installation of additional snow fence along SR-31, SR-72, SR-10, SR-24 and SR-143 with the



\$400,000 efficiency from the fiscal year 2012 Snow Budget will allow for future cost savings related to snow removal on these routes. The use of snow fences offers operational savings because they reduce the need for snow removal crews along the routes. In addition, roadway safety and accessibility is improved and users are more protected against snow drifting across the routes. Additional savings are created by the installation of gravity flow brine tanks. Gravity tanks decrease the

need to pump brine for snow removal and thus reducing the down time for snow removal activities.

Innovative snow removal efficiencies enhance road safety and accessibility. These initiatives are estimated to save \$124,000 per year in operational costs.